STIMULATION PROGRAM
LAC 43: XVII.3607(C)(2)(h)

Project Name: Live Oak CCS Hub

Facility Information

Facility Contact: Live Oak CCS, LLC
14302 FNB Parkway
Omaha, Nebraska 68154
402-691-9500

OOC Code No.: L1135

Well Locations:

Well Name	Latitude (WGS84)	Longitude (WGS84)	Parish	State
LO-01 M[1]	Claimed as PBI	[redacted]	West Baton Rouge	Louisiana
LO-01 F[1]	Claimed as PBI	[redacted]	West Baton Rouge	Louisiana
LO-02 M	Claimed as PBI	[redacted]	West Baton Rouge	Louisiana
LO-03 M	Claimed as PBI	[redacted]	Iberville	Louisiana
LO-04 F-M	Claimed as PBI	[redacted]	Iberville	Louisiana
LO-05 M	Claimed as PBI	[redacted]	Iberville	Louisiana
LO-06 M[1]	Claimed as PBI	[redacted]	Iberville	Louisiana
LO-06 F[1]	Claimed as PBI	[redacted]	Iberville	Louisiana

[1] For shared well pads, surface hole location spacing is set at a minimum of 15 feet.

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List of Acronyms

BHA	Bottom-Hole Assembly
CCS	Carbon Capture and Storage
CO_2	Carbon Dioxide
LMIC	Lower Miocene Injection Complex
N_2	Nitrogen Gas
OC	Louisiana Department of Energy and Natural Resources' Office of Conservation
OFIC	Oligocene Frio Injection Complex
PBTD	Plug Back Total Depth
RIH	Run In Hole
UIC	Underground Injection Control

1. Introduction/Purpose

Stimulation to enhance the injectivity potential of the injection zone at Live Oak CCS Hub in Iberville and West Baton Rouge parishes, Louisiana (the "project") may be necessary. Stimulation may involve, but is not limited to, pumping fluids into or flowing fluids out of the well, increasing or connecting pore spaces in the injection formation, or other activities that are intended to allow the injectate to move more readily into the sequestration formation. This Stimulation Program is provided in accordance with LAC 43:XVII.3607(C)(2)(h) and describes any fluids that will be utilized for stimulation activities and demonstrates that the stimulation will not interfere with containment.

Prior to conducting stimulation activities on any of the injection wells, Live Oak CCS, LLC will submit Form UIC-17 along with the proposed procedure for stimulation activity to the Louisiana Department of Energy and Natural Resources' Office of Conservation (OC) and will obtain a written work authorization as per LAC XVII.3621(A)(9). The OC may deny the stimulation; approve the stimulation as proposed; or approve the stimulation with conditions. Live Oak CCS, LLC will carry out the stimulation program, including any conditions, as approved or set forth by the OC.

Stimulation measures may be required for this project to mitigate drilling-induced damage near the wellbore. It is expected to effectively clear the perforated interval of fines, perforation charge residue, and debris from cement or casing. Additionally, stimulation serves to eliminate drilling mud filtrate and dissolved minerals present in the formation. This process is common, as the untreated presence of these elements can lead to elevated downhole injection pressures and diminished injectivity, underscoring the significance of thorough treatment.

Data from offset wells in the region indicate a possibility of formation sand entering the wellbore during interruptions in CO_2 injection in the Lockport Medina Injection Complex (LMIC). This could obstruct the CO_2 pathway from the tubing to the formation, increase downhole pressure, and limit injectivity. To address this potential sand issue, various mitigation methods were explored Sand control screens to limit sand infiltration are proposed for wells injecting in the LMIC (i.e., LO-1 M, LO-2 M, LO-3 M, LO-5 M and LO-06 M). Further details on sand control screens can be found in subsection 2.5 of the Construction Details for these wells. A resin control system in the Miocene formation without the need of screens is proposed for LO-04 F-M which injects into both the LMIC and Oligocene Frio Injection Complex (OFIC). Liquid resin will be pushed into the perforations to consolidate sand particles and prevent sand production while maintaining matrix permeability for CO_2 injection. The safest, most efficient, and long-term sand control mitigation method will be developed following data collection anticipated with the pre-operational testing program. The necessity for mitigation efforts will be re-evaluated before seeking authorization to inject.

2. Stimulation Fluids

Matrix stimulation utilizing acid will be planned based on reservoir minerology, depth of damage, fluid invasion, temperature, and connate fluid properties. The exact composition of stimulation fluids, including the volumes and concentrations, will be determined after completion of the pre-operational testing program and determination that stimulation is needed, and will consider well

and surface conditions. CO_2 or N_2 may be blended with acid and other aqueous based fluids during pumping and displacement to facilitate better treatment placement and recovery (foamed acid stimulation). Diverting agents may be used to ensure the treatment is placed into the highest priority perforations.

The resin control sand system will be designed based on a variety of factors including, but not limited to, permeability, formation water salinity, in-situ mineralogy, temperature, pressure, adherence to sand grains, strength, resistance to CO_2 stream, and formation sand particle size distribution data collected using core run through mechanical sieve analysis or laser particle sieve analysis. Well and surface conditions, along with data collected during the pre-operational testing program, will be used to determine the composition, volume, and concentration of pre flush, resin, spacer, post flush, and any other fluid used in the treatment.

The purpose of stimulation, stimulation fluids to be used, and anticipated volumes and concentrations of stimulation fluids will be provided to the OC in the proposed stimulation procedure in advance notification as described in Section 1.0 above.

3. Additives

The specific additives to be employed will be contingent upon the prevailing well conditions, and their selection remains to be determined, dependent on compatibility testing. An example of typical additives includes the following:

- Corrosion inhibitors: serve to mitigate the corrosive impact of treatment chemicals on both surface and downhole metals and alloys;
- Surfactants: aid in the efficient removal of drilling mud from the formation, alleviate incompatibility issues, and enhance fluid recovery during flowback;
- Iron control agents: contribute to stabilization, thereby preventing the precipitation of iron, which could otherwise impair formation permeability;
- Non-emulsifiers: play a crucial role in averting emulsion formation by regulating interfacial tension between acid treatment and formation fluid;
- Clay stabilizers: reduce the likelihood of clay streaks swelling; and
- Biocides: assist in controlling sulfate-reducing or iron-oxidizing bacteria.

If it is determined that an additive is needed for stimulation, the purpose of the additive, additive to be used, and anticipated volume and concentration of additive will be provided to the OC in the proposed stimulation procedure in advance notification as described in Section 1.0 above.

4. Diverters

Diverters may be used to uniformly distribute the acid treatment along the targeted interval, though the specific diversion method and material will be evaluated based on the conditions of the well prior to injection. A formalized diversion plan will be finalized based on the well conditions.

If it is determined that a diverter is needed for stimulation, the composition, treatment schedule, and volumes will be provided to the OC with a proposed procedure and advanced notification as described in Section 1.0 above.

5. Stimulation Procedures

A multi-step evaluation process will be used prior to the actual stimulation and/or treatment program.

1. Determine effect and nature of damage.
2. Select fluid chemistry, volume, treatment schedule, and pressure.
3. Determine a proper treatment additive program.
4. Determine a treatment placement method.
5. Recover treatment fluids and any reaction products.
6. Analyse treatment effectiveness and additional treatment design as required.

5.1 Matrix Stimulation

The stimulation process will involve spotting and placing an acid treatment into the formation across the injection intervals and allowing for adequate soak time. The well will then be flowed back, circulated, or swabbed to recover the treatment slurry and fines. Live Oak CCS, LLC will make sure that the treating pressure is maintained below the maximum permitted pressure. The anticipated steps include:

1. Run in hole (RIH) to plug back total depth (PBTD) with bit and casing scraper, working across any suspected obstructions and across perforated interval.
2. Circulate or reverse clean with working fluid. Utilize viscous pill if needed.
3. Retrieve scraper assembly from well and RIH with tailpipe and retrievable packer.
4. Spot lead stimulation fluid across perforations and set packer.
5. Inject treatment and flow back after soak time. Repeat with additional treatments if necessary.
6. Release packer and reverse spent acid and any solids from wellbore. If reverse circulation is not possible, lay down packer and circulate clean with bit and slick bottom-hole assembly (BHA).

5.2 Sand Production Treatment

Resin control system may be required for CO_2 injection in the Miocene formation. Given the limited available data from offset wells, especially formation sand particle size distribution, the specific sand control treatment details are not specifically defined. After data collection from the pre-operational testing program, laboratory tests (such as sand pack permeability, unconfined compressive strength, CO_2 aging) will be conducted to determine the methodology, volume of resin, and additives required. Live Oak CCS, LLC will submit a written request along with proposed procedure to the OC and will receive written approval before proceeding with any simulation activities as per LAC XVII.3621(A)(9).